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Weed population, nitrogen removal by weeds and crop yield under maize + blackgram intercropping system in Chhattisgarh plains

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ABSTRACT

The experiment consisted of five planting geometry *viz*., sole maize, sole blackgram, maize + blackgram (1:1), maize + blackgram (2:1) and maize + blackgram (2:2) and four weed management practices *viz*., weedy check, hand weeding (HW) at 30 DAS, alachlor 2.0 kg/ha as pre emergence (PRE) and alachlor 1.5 kg/ha as PRE + HW at 40 DAS. These treatments were evaluated under split plot design with three replications. At harvest of maize (105 DAS), weed population and nitrogen removals of all species of weeds were significantly highest under sole maize. However, the highest nitrogen removal by weeds was recorded under weedy check by all the weed species, while the lowest removal of nitrogen was in alachlor 1.5 kg/ha + HW at 40 DAS. Among the planting geometry, the grain yield, productivity rating index (PRE), production efficiency (PE) and weed control efficiency (WCE) were highest under maize + blackgram (2:1) for maize, however weed smothering efficiency of maize was highest under maize + blackgram (1:1). The same parameters were highest under sole blackgram. At harvest stages of blackgram (75 DAS) and maize (105 DAS), dry weight of weeds was lowest with the application of alachlor 1.5 kg/ha + HW at 40 DAS. This treatment produced maximum grain yield, PRI and PE of maize and blackgram, along with higher WCE.

Key words: Weed management, Maize, Blackgram, Intercropping

Weed management in intercropping system needs concentrated efforts to provide weed free environment to both the crop components. The development of wide spectrum herbicide in the recent past has opened up excellent opportunities for chemical weed control in component crops of differential nature growing in association with each other. The safe herbicide for an intercropping system would be the one option, which controls the weed flora effectively till the component crops develop their own canopy to combat weeds. Alachlor a broad spectrum herbicide could safely be used in different intercropping systems for controlling dicot and monocot weeds. Physical manipulations of the intercrop environment for weed control very closely resemble those used for sole crops. Many researchers have suggested competitive crop cover and high plant density to reduce weed growth (Altieri and Liebman 1986). Intercropping offers the possibility of a mixture of crops capturing a great share of available resources than in monocropping, preempting their use by weeds. Besides, intercropping also reduces weeding cost and realizes higher total productivity of the system and monetary return (Pandey and Prakash 2002). But this system alone is not sufficient to ensure adequate weed control because of varied canopy coverage by intercrops. Planting geometry, which modifies the crop canopy structure and micro-climate, in combination with weed management practices, may influence weed infestation to a great extent. Hence, an attempt was made to integrate manual and chemical weeding in addition to planting geometry.

MATERIALS AND METHODS

Field experiments were conducted at Instructional Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh) during *kharif* season of 2004 and 2005 under split plot design with three replications. The experiment consisted of five planting geometry *viz*., sole maize (45 cm), sole blackgram (30 cm), maize (45 cm) + blackgram (1:1), maize (30 cm) + blackgram (2:1) and maize (30 cm) + blackgram (2:2) and four weed management practices *viz*., weedy check, HW at 30 DAS, alachlor 2.0 kg/ha as pre emergence PRE and alachlor 1.5kg /ha as (PRE) + HW at 40 DAS. The experimental soil was Vertisols (typical fine montmorillonitic, hyperthermic, udic choromuster) with pH 7.2, EC 0.12 ds/m and available N, P and K of 216, 12.10 and 366 kg/ha, respectively. The application of fertilizer in sole maize was 100:60:40 kg N:P:K/ha, whereas in the case of sole blackgram, application of fertilizer was 20:40:20 kg N:P:K/ha. The composite maize *'Navjot'* and blackgram *'TAU-2'* was sown on 12^{th} July, 2004 and 13^{th} July, 2005 with the plot size 37.8 m^2. Alachlor was applied threough

Knapsack sprayer using flat-fan nozzle as per the treatment. The amount of herbicide and water (500 litre/ha) required was calculated on the basis of land area to be sprayed. Weedy plots remained infested with natural population of weeds till the harvesting of crops with root elongation. The blackgram was harvested on 4th to 7th October, 2005, wereas, maize was harvested on 17th to 22nd October 2004 and 21st to 25th October 2005. The total N content in weed (at harvest of crops) was determined by Kjeldhal method. The uptake of nitrogen by weeds at harvest of crops was calculated by multiplying the dry matter accumulation of weeds (kg ha^{-1}) at harvest with the respective percentage composition of nitrogen. Weed smothering efficiency (WSE) is the capacity of intercrop to suppress the weeds as compared to sole crop. It is calculated with the following formula and expressed in percentage.

$$WSE = \frac{DMS - DMI}{DMS} \times 100$$

Where, DMS: Dry matter of weeds of sole crop, DMI: Dry matter of weeds of inrtercrop and WSE: Weed smothering efficiency. The Productivity Rating Index (PRI) pertaining to maize crop was worked out with following formula to judge the performance of the treatments.

$$PRI\ (\%) = \frac{\text{Yield of the crop under a particular treatment (t ha}^{-1})}{\text{Standard yield of the crop (t ha}^{-1})} \times 100$$

The standard yield of maize was considered 2000 kg/ha. The standard yield of blackgram was considered 300 kg/ha.

RESULTS AND DISCUSSION

Weeds population

Out of seven weed species, *Alternanthera sessilis* and *Cyperus rotundus* among sedges, *Cynodon dactylon* among grasses and in broad leaf weeds *Cynotis axillaries* were predominant weeds infesting the experimental field (Table 1). At 75 DAS of blackgram, weed population of different species were significantly higher under sole maize compared to other treatments during both the years (Table 2). Among planting geometry treatment, maize + blackgram (1:1) resulted in lowest weed density of *C. axillaries, C. dactylon,* and *C. rotundus,* whereas lowest population of *A. sessilis, Brachiaria ramosa* and other weeds was noted under sole blackgram. Here, it may be argued that blackgram reduced the population and dry weight of weeds due to its smothering effect. The weed suppression due to smother of crop was about the same as that obtained with two HW. Rana and Pal (1989), Kurchania *et al.* (1995) and Dubey (1998) also reported similar findings. Alachlor 1.5 kg /ha + HW at 40 DAS effectively controlled weeds compared to other treatments during both the years. On the other hand, highest weed population was observed under weedy check over HW at 30 DAS, alachlor 2.0 kg/ha and alachlor 1.5 kg/ha + HW at 40 DAS. Application of alachlor 1.5 kg/ha + HW at 40 DAS significantly controlled all the species of weeds over weedy check as well as HW at 30 DAS and alachlor 2.0 kg/ha. At 105 DAS of maize, weed population of all species of weeds were significantly highest under sole maize as compared to other treatments, during both the years (Table 3). Among the intercropping treatments, significantly the lowest weed population of all species were observed under maize + blackgram (1:1). Weed management practices had statistically significant effect on weed population during both the years. The lowest weed population of all species was registered under application of alachlor 1.5 kg/ha + HW at 40 DAS in comparison to other treatments during both the years. Alachlor 1.5 kg/ha + HW at 40 DAS gave the best performance in controlling all the weed species over weedy check as well as HW at 30 DAS and alachlor 2.0 kg/ha.

Weed control efficiency

Highest weed dry matter production was observed under sole maize, which was significantly higher in comparison to other treatments, during both the years. As regards to weed management, alachlor 1.5 kg/ha + HW at 40 DAS had registered significantly lowest amount of dry matter production of all species of weeds, during both the years. At the same stage highest dry matter production was observed under weedy check treatment during both the years. It shows that the combine or integrated approach is more beneficial in controlling weeds than the HW or chemical approach alone (Chandel *et al.* 1995, Vairavan *et al.* 1997). WCE at 75 DAS for blackgram was highest under alachlor 1.5 kg/ha + HW at 40 DAS (92 and 91%) followed by HW at 30 DAS treatment (75 and 76%) and alachlor 2.0 kg/ha (69 and 69%) during both the years (Fig.1). WCE at harvest of maize was significantly influenced by weed management, where all the weed management treatments resulted in increased WCE over the weedy check during both the years of the experimentation. The highest WCE was observed under alachlor 1.5 kg/ha + HW at 40 DAS (86 and 83%) which was followed by alachlor 2.0 kg/ha (60 and 59%) and HW at 30 DAS (59 and 53%) during both the years (Fig. 1).

Table 1. In predominant weed flora in the experimental field

Botanical Name	Common name	Family	Local name	Growth habit*
Sedges				
Cyperus rotundus	Purple nutsedge	Cyperaceae	*Motha*	P M Rs Rv
Alternanthera sessilis	Joyweed	Amaranthaceae	*Resham kanta*	A D Rs Rv
Grassy Weeds				
Cynodon dactylon	Bermuda grass	Poaceae	*Doob grass*	P M Rs Rv
Brachiaria ramosa	Signal grass	Poaceae	*Shipi*	A M Rs Rv
Broad leaf weeds				
Convolvulus arvensis	Field bindweed	Convolvulaceae	*Hirankhuri*	A D Rs Rv
Phyllanthus niruri	Niruri	Euphorbiaceae	*Hazardana*	A D Rs
Cynotis axillaries	Cyanotis grass	Commelinaceae	*Kena*	A D Rv Rs

*A - Annual; P - Perennial; D - Dicot; M - Monocot, Rs - Reproducing by seeds; Rv - Reproducing by vegetative means

Weed smothering efficiency of maize

Weed smothering efficiency (WSE) at harvest of maize are presented Fig. 2. WSE was appreciably influenced by planting geometry at harvest of maize during both the years. The highest WSE was obtained under maize + blackgram (1:1) which was remarkably higher over maize + blackgram (2:2) and maize + blackgram (2:1) during both the years. This confirms the findings of Pandey and Prakash (2002).

Nitrogen removal by weeds

Different planting geometry appreciably influenced N removal by weeds during both the years. In general, the highest nitrogen removal by weeds was noted in sole maize, while lowest removal of nitrogen was registered under sole blackgram (Table 4). However, the lowest nitrogen removal by *C. dactylon, C. axillaris* and *C. rotundus* (first year only) was noted under maize + blackgram (1:1). The highest nitrogen removal by weeds was obtained under weedy check by all the weed species, while the lowest removal of nitrogen was noted under alachlor 1.5 kg/ha + HW at 40 DAS. Nitrogen removal by all species of weed was influenced significantly due to planting geometry and weed management practices. In planting geometry, sole maize allowed the highest removal of nitrogen in all species of weeds *viz. A. sessilis, C. axillaries, C. dactylon, B. ramosa, C. rotundus* and other weeds over rest of the treatments, during both the years. In case of planting geometry, lowest removal of nitrogen by all species of weeds was noted under maize + blackgram (1:1) over other treatments (Table 4). Alachlor 1.5 kg/ha + HW at 40 DAS removed lower amount of nitrogen by all species of weeds in comparison to other treatments. The significantly higher amount of nitrogen removal was depicted under weedy check treatment with respect to all weed species. It may also be seen from the examination of Table 4 that uncontrolled weeds depleted 20.47 and 19.29 kg N/ha at 78 days stage for blackgram crop; 32.1 and 31.75 kg N/ha at 105 days stage of maize crop during 2004 and 2005, respectively in weedy check plots which was significantly higher than that of all other treatments. The least reduction in the uptake of these nutrients by the weeds was obtained in alachlor 1.5 kg/ha+HW at 40 DAS, which may attributed to the reduction in total density of weeds caused by treatment. Nutrient uptake by weeds at their active growth stage have also been reported by Muthuvel *et al.* (1988) and Ramamoorthy and Lakshmanachary (1997). Among the planting geometry maize + blackgram (2:1) found to be best in terms of maize yield and sole blackbgram in terms of blackgram yield. The application of alachlor 1.5 kg/ha +HW at 40 DAS, resulted in significantly highest grain yield of maize and blackgram (Dixit and Gautam 1996, Malai and Muthusankaranarayanan 1999).

Grain yield, productivity rating index (PRI) and production efficiency (PE)

Maize: In respect to planting geometry treatments, the grain yield, PRI and PE were significantly highest with the treatment of maize + blackgram (2:1) followed by maize + blackgram (1:1). However, it was the lowest under maize + blackgram (2:2). All the weed management practices recorded significantly higher values of grain yield, PRI and PE over weedy check during both the years. Application of alachlor 1.5 kg/ha + HW at 40 DAS recorded significantly higher values over other weed management practices during both the years. (Table 5).

Blackgram: Under various treatment of planting geometry, the grain yield, PRI and PE were significantly highest under sole blackgram and the lowest was observed

Table 2. Species wise plant population of weeds (/m^2) at harvest of blackgram (78 DAS) as influenced by planting geometry and weed management in maize + blackgram intercropping system

Treatment	Plant population (/m^2) of weeds at 75 DAS											
	Alternanthera sessilis		*Cynotis axillaris*		*Cynodon dactylon*		*Brachiaria ramosa*		*Cyperus rotundus*		Others	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
Planting Geometry												
P_1 - Maize sole	3.5	3.2	2. 8	2.9	2.2	2.4	2.6	3.1	2.2	2.1	2.5	2.5
	(14.5)	(11.2)	(8.6)	(9.4)	(5.3)	(6.2)	(8.7)	(10.0)	(5.1)	(4.4)	(6.4)	(6.4)
P_2 - Blackgram sole	2.7	2.5	2.6	2.7	2.2	2.4	2.2	2.2	1.8	1.7	1.8	1. 8
	(9.2)	(8.2)	(7.4)	(7.9)	(5.1)	(6.0)	(5.3)	(5.3)	(3.3)	(2.7)	(3.3)	(3.2)
P_3 - Maize + blackgram (1:1)	3.1	2.9	2.2	2.2	1.8	1.8	2.3	2.4	1.6	1.6	1.9	1.9
	(11.8)	(10.5)	(5.0)	(5.0)	(3.4)	(3.3)	(6.1)	(6.1)	(2.4)	(2.3)	(3.8)	(3.5)
P_4 - Maize + blackgram (2:1)	3.3	3.3	2.5	2.6	2.0	2.2	2.5	2.6	2.0	2.0	2.3	2.3
	(12.9)	(13.5)	(6.7)	(6.7)	(4.7)	(5.1)	(7.1)	(7.3)	(4.3)	(4.1)	(5.3)	(5.2)
P_5 - Maize + blackgram (2:2)	2.9	2.9	2.3	2.4	1.9	2.1	2.4	2.5	2.0	1. 9	2.1	2.2
	(10.7)	(10.3)	(5.7)	(6.2)	(4.0)	(4.8)	(6.7)	(6.9)	(3.9)	(3.5)	(4.2)	(4.8)
LSD (P=0.05)	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Weed Management												
W_1 - Weedy check	5.7	5.6	3.9	4.0	3.6	3.6	4.3	4.2	2.9	2.7	3.4	3.4
	(34.0)	(30.5	(14.7)	(15.5)	(12.5)	(12.7)	(18.1)	(17.2)	(8.0)	(7.1)	(10.8)	(10.9)
W_2 - HW at 30 DAS	2.2	2.2	2.0	2.0	1.4	1.6	1. 9	2.3	2.1	2.0	1.5	1.5
	(4.6)	(4.4)	(3.6)	(3.6)	(1.5)	(2.3)	(3.1)	(5.1)	(4.1)	(3.4)	(1.9)	(1.8)
W_3 - Alachlor 2.0 kg/ha	2.6	2.5	2.8	2.9	1.9	2.2	2.4	2.3	1.8	1.7	2.0	2.1
	(6.3)	(6.0)	(7.2)	(7.9)	(3.2)	(4.2)	(5.2)	(4.8)	(2. 8)	(2.4)	(3.8)	(4.0)
W_4 – Alachlor 1.5 kg/ha+HW at 40 DAS	1.7	1.6	1.3	1.3	1.2	1.3	1.1	1.4	0.9	1.1	1. 6	1.5
	(2.7)	(2.0)	(1.2)	(1.3)	(0.8)	(1.1)	(0.8)	(1.5)	(0.2)	(0.7)	(2.0)	(1.7)
LSD (P=0.05)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Original values are given in parenthesis

Table 3. Species wise plant population of weeds (/m^2) at harvest of maize (105 DAS) as influenced by planting geometry and weed management in maize + blackgram intercropping system

Treatment	Plant population (m^2) of weeds at harvest											
	Alternanthera sessilis		*Cynotis axillaris*		*Cynodon dactylon*		Brachiaria *ramosa*		*Cyperus rotundus*		Others	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
Planting Geometry												
P_1 - Maize sole	4.4	4.1	3.3	3.4	2.7	2.8	4.6	4. 8	2.5	2.7	2.6	2.6
	(20.9)	(18. 8)	(11.9)	(12.7)	(7.8)	(8.5)	(22.8)	(23. 3)	(7.3)	(7.3)	(8.2)	(8.4)
P_2 - Blackgram sole	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1.0	1.0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.8)	(0. 8)
P_3 - Maize +blackgram (1:1)	3.6	3.9	2.6	2.7	2.1	2.1	3.6	3.6	1.6	1.6	2.5	2.5
	(14.0)	(15. 6)	(7.2)	(7.5)	(4.6)	(5.0)	(14.0)	(13.8)	(2.2)	(2.1)	(6.5)	(6.7)
P_4 - Maize +blackgram (2:1)	4.0	4.2	3.1	3.2	2.4	2.6	4. 2	4.4	2.4	2. 5	2.9	2.9
	(17.1)	(18.8)	(10.5)	(11.0)	(6.2)	(7.3)	(18.6)	(20.3)	(6.5)	(6.1)	(8.5)	(8.8)
P_5 - Maize +blackgram (2:2)	3.8	3.7	2.9	3.0	2.2	2.4	3.9	3.9	2.3	2.2	2.7	2.7
	(15.6)	(15.0)	(8.8)	(9.3)	(5.2)	(6.4)	(16.4)	(16.3)	(5.9)	(5.2)	(7.5)	(7.6)
LSD (P=0.05)	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.2	0.2
Weed Management												
W_1 - Weedy check	4.9	4.9	3.6	3.7	3.3	3.5	5.0	4.4	3.0	2.7	3.5	3.6
	(27.7)	(28.2)	(15.0)	(15.8)	(12.5)	(13.7)	(24.5)	(22.9)	(10.5)	(8.2)	(13.8)	(14.6)
W_2 - HW at 30 DAS	3.1	3.1	2.2	2.3	1.6	1.6	3.3	3.7	2.2	2.2	1.9	1.9
	(10.5)	(10.6)	(5.3)	(5.5)	(2.2)	(2.6)	(12.4)	(15.3)	(5.2)	(4.8)	(3.4)	(3.6)
W_3 - Alachlor 2.0 kg/ha	3.3	3.2	2.9	3.0	1.8	2.0	3.9	4.0	1.4	1.5	2.3	2.2
	(11.8)	(11.7)	(8.9)	(9.4)	(3.2)	(4.1)	(17.3)	(16.5)	(1.5)	(2.1)	(5.4)	(4.9)
W_4 - Alachlor 1.5 kg/ha+ HW at 40 DAS	2.1	2.0	1.39	1.4	1.3	1.4	1.8	2.0	0.9	1.3	1.7	1.7
	(4.0)	(4.0)	(1. 6)	(1.7)	(1.2)	(1.5)	(3.2)	(4.2)	(0.3)	(1.4)	(2.6)	(2.7)
LSD (P=0.05)	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1

Original values are given in parenthesis

Table 4. Nitrogen removal by weeds at harvest of blackgram (78 DAS) and maize (105 DAS) as influenced by planting geometry and weed management in maize + blackgram intercropping system

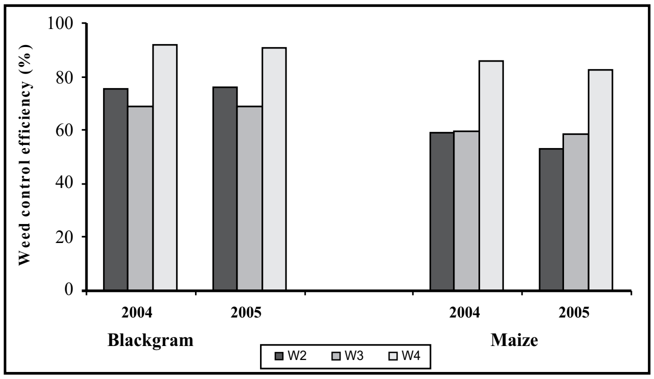
Treatment	Nitrogen removal at harvest (kg/ha)											
	Alternanthera sessilis		*Cyperus rotundus*		*Brachiaria ramosa*		*Cynotis axillaris*		*Cynodon dactylon*		Others	
	2004	**2005**	**2004**	**2005**	**2004**	**2005**	**2004**	**2005**	**2004**	**2005**	**2004**	**2005**
Planting Geometry												
P_1-Maize sole	4.8	3.6	0.8	0.7	1.2	1.4	0.4	0.4	0.6	0.6	2.3	2.4
	(8.6)	(8.0)	(1.3)	(1.4)	(3.8)	(3.9)	(0.8)	(0.9)	(1.0)	(1.2)	(3.9)	(4.0)
P_2-Blackgram sole	2.7	2.6	0. 8	0.6	0.8	0.8	0.4	0.4	0.6	0.6	1.5	1.5
	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
P_3-Maize + blackgram (1:1)	3.9	3.6	0.5	1.3	0. 9	0.9	0.2	0.2	0.5	0.5	1.7	1.7
	(5.7)	(5.4)	(1.2)	(1.2)	(2.4)	(2.3)	(0.5)	(0.5)	(0.9)	(0.9)	(2.7)	(3.0)
P_4-Maize + blackgram (2:1)	4.2	4.4	0.8	0.7	1.0	1.1	0.4	0.3	0.5	0.5	2.1	2.2
	(6.6)	(6.7)	(1.3)	(1.3)	(3.1)	(3.4)	(0.7)	(0.8)	(1.0)	(1.2)	(3.8)	(4.0)
P_5-Maize + blackgram (2:2)	3.4	3.1	0.8	0.6	1.0	1.1	0.3	0.3	0.5	0.5	1.9	1.9
	(5. 9)	(6.0)	(1.4)	(1.1)	(2.9)	(2.9)	(0.6)	(0.7)	(0.9)	(1.1)	(3.7)	(3.7)
LSD (P=0.05)	1.1	1.1	0.2	0.3	0.3	0.3	0.1	0.1	NS	0.2	0.5	0.5
	(2.1)	(2.0)	(NS)	(NS)	(0.8)	(0.8)	(0.2)	(0.2)	(NS)	(NS)	(1.0)	(NS)
Weed Management												
W_1-Weedy check	9.8	9.2	1.7	1.4	2.7	2.5	0.8	0.7	1.4	1.3	4.2	4.1
	14.1)	(14.0)	(3.1)	(2.4)	(5.2)	(4.8)	(1.3)	(1.4)	(2.4)	(2.6)	(6.1)	(6.4)
W_2-HW at 30 DAS	2.0	1. 6	0.7	0.5	0.5	0.7	0.2	0.2	0.2	0.2	0.7	0.8
	(5.4)	(5.1)	(1.5)	(1.6)	(2.6)	(3.2)	(0.5)	(0.5)	(0.4)	(0.7)	(2.3)	(2.7)
W_3-Alachlor 2.0 kg/ha	2. 7	2.4	0.5	0.4	0.8	0.7	0.3	0.3	0.4	0.4	2.0	2.0
	(5.1)	(5.0)	(0.5)	(0.6)	(3.7)	(3.5)	(0.7)	(0.7)	(0.6)	(0.7)	(3.7)	(3.4)
W_4 - Alachlor 1.5 kg/ha + HW at 40 DAS	0.85	0.6	0.1	0.7	0.1	0.2	0.1	0.1	0.1	0.2	0.7	0.8
	(2.3)	(2.1)	(0.1)	(0.3)	(0.7)	(0.9)	(0.2)	(0.2)	(0.4)	(0.4)	(1.9)	(2.1)
LSD (P=0.05)	0.9	0.9	0.2	0.2	0.3	0.24	0.1	0.1	0.1	0.1	0.4	0.4
	(1.6)	**(1.6)**	**(0.3)**	**(0.3)**	**(0.7)**	**(0.7)**	**(0.2)**	**(0.2)**	**(0.3)**	**(0.3)**	**(0.8)**	**(0.8)**

Data of nitrogen removal by weeds is maize is given in parenthesis.

Table 5. Grain yield, PRI and PE of maize and blackgram as influenced by planting geometry and weed management in maize + blackgram intercropping system

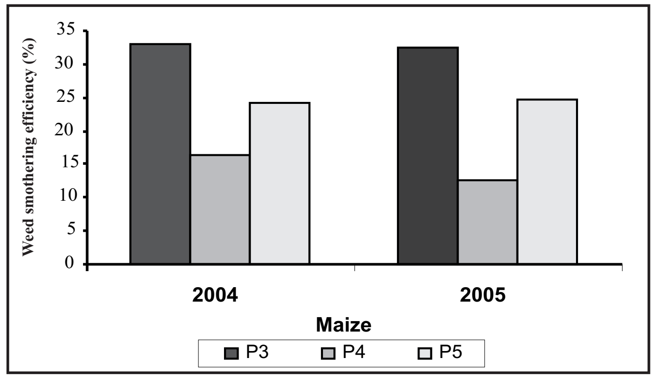
Treatment	Maize						Blackgram					
	Grain yield (kg/ha)		PRI		PE		Grain yield (kg/ha)		PRI		PE	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
Planting Geometry												
Maize sole	2935	2142	146.8	107.1	28.8	20.8	-	-	-	-	-	-
Blackgram sole	-	-	-	-	-	-	633	665	211.2	221.9	8.1	8.5
Maize + Blackgram (1:1)	3080	2235	154.0	111.8	30.2	21.7	382	453	127.5	151.1	4.9	5.8
Maize + Blackgram (2:1)	3143	2311	157.2	115.6	30.8	22.4	190	329	63.4	109.8	2.4	4.2
Maize + Blackgram (2:2)	2356	1738	117.8	86.9	23.1	16.9	293	411	97.8	137.8	3.7	5.3
LSD (P =0.05)	163	152	8.2	7.7	1.6	1.5	31.5	43.4	14.8	21.9	0.6	0.8
Weed Management												
Weedy check	2117	1538	105.9	76.9	20.8	14.9	265	253	88.3	84.5	3.4	3.3
HW at 30 DAS	3096	2224	154.8	111.2	30.4	21.6	407	488	135.8	162.7	5.2	6.2
Alachlor 2.0 kg/ha	2931	2056	146.6	102.8	28.7	20.0	400	516	133.3	172.0	5.1	6.7
Alachlor 1.5 kg/ha + HW at 40 DAS	3370	2608	168.5	130.5	33.1	25.3	427	602	142.4	200.8	5.4	7.7
LSD (P=0.05)	70	130	3.5	6.6	0.7	1.3	18.3	28.6	12.7	15.4	0.5	0.6

PRI - Productivity rating index, PE - Production efficiency



W_2 - Hand weeding at 30 DAS
W_3 - Alachlor 2.0 kg/ ha
W_4 - Alachlor 1.5 kg/ ha+ HW at 40 DAS

Fig. 1. WCE (%) at 75 days of blackgram and at 105 DAS of maize as influenced by weed management in maize + blackgram intercropping system



P_3 - Maize + Blackgram (1:1)
P_4 - Maize + Blackgram (2:1)
P_5 - Maize + Blackgram (2:2)

Fig. 2. WSE efficiency (%) at 105 DAS of maize as influenced by planting geometry in maize + blackgram intercropping system

under maize + blackgram (2:1). All weed management practices recorded significantly higher values of grain yield, PRI and PE over weedy check during both the year. Application of alachlor 1.5 kg/ha + HW at 40 DAS recorded significantly higher values over rest of all weed management practices during both the years, however, during first year it was found to be at par to HW at 30 DAS and alachlor 2.0 kg/ha. Several workers also advocated about the integrated approach of weed management including chemical and mechanical methods for obtaining more net return and benefit : cost ratio (Satao *et al.* 1995, Krishnasamy and Krishnasamy 1996, Ramamoorthy *et al.* 1995 and Pandey *et al.* 2001).

Results of the present investigation suggest that, among the planting geometry maize + blackgram (2:1) found to be best in terms of maize yield and sole blackbgram in terms of blackgram yield. The application of alachlor 1.5 kg/ha + HW at 40 DAS, resulted in significantly highest grain yield, PRI, PE of maize and blackgram. The weed control efficiency was also higher in the same combination.

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